Air Force Materiel Command

War-Winning Capabilities … On Time, On Cost

U.S. AIR FORCE

AFMC Sponsored Transformational Opportunity Study of AFRL

June 3, 2005

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Integrity - Service - Excellence

Panel Members

- **Gen (R) Richard Hawley** — **Consultant, ACC/CC (96-99) & SAF/AQ (93-95)**
- **Dr. Vincent Russo, SES (R)** — **Consultant, ASC/CD(98-03), Wright Lab Dep Dir (97-98), Materials Lab Dir (90-97)**
- **Lt/Gen (R) Steve Plummer** — **Senior VP, Def Relations, Rolls-Royce NA, AF/SAB, SAF/AQ & S&E Func Mgr (00-03), AF/XPP (99-00)**
- **M/G (R) Robert Rankine** — **Consultant, VP Hughes Space & Comm. (95-00), AFSC/ST (90-92), SMC/CV (87-90)**
- **Dr. Tony Hyder** — **Assoc VP, Grad Studies & Research, Prof. of Physics, Univ of Notre Dame, AF/SAB, DIAAB, ASB**
- **Mr. James Sinnett (R)** — **Consultant, MDC/Boeing Engr & Tech VP (86-01), Founder of Phantom Works**
- **Dr. Thomas Cruse, SES** — **AFRL/CT, IPA; AF/SAB, Professor/Associate Dean**
- **Col (R) John Warden** — **President of Venturist, Inc., ACSC Cmdt (92-95), Author: *The Air Campaign & Winning in FastTime***
- **Maj Jonathan Specht** — **AFMC Tech Transition Office (AFMC/XRS), AFMC ATC Mgr, Former Global Hawk Development Lead**
- **Capt Justin Swartzmiller** — **Exec. Officer to AFRL/CT, Logistics Readiness Officer**

Terms of Reference

Objective and Scope December 2004

Several potential transformational opportunity areas have been identified for initial examination by the Transformational Opportunity Study team. After an initial review, the team will identify which specific areas, either from those identified below or others discovered during the course of evaluation, have the greatest potential to benefit from transformation. The study team will continue to explore these areas and make specific recommendations to focus transformation activities. The initial set of objectives includes:

Terms of Reference

1. **Review AFRL's customer base to access customer perceptions of AFRL's value. Assess the process for balancing near, mid and far term efforts. Assess the utility of a follow-on study to compare AFRL with other Service labs.**
2. **Assess the relevance of AFRL structure (XP staff, Technology Directorates, etc.) and processes in support of capability based planning and developing integrated cross directorate, multi-disciplinary concepts/solutions.**
3. **Mechanisms for Technology Transition--what's the next level? What opportunities exist to further facilitate timely transition of relevant technologies to warfighter systems?**
4. **Assess the impact of capability based planning on AFRL policy and processes for approving the initiation of research projects and prioritizing the allocation of resources. Consider the impact of recent Air Force and AFMC organizational and process changes, i.e. PEOs, CRRA, Center Re-org, etc.**

Terms of Reference

5. Assess the utility of a follow-on study of the AFRL relationships with DOD and National Labs.
6. Provide limited insights on the degree of interaction with industry as a source of ideas and as a resource to leverage when developing and transitioning new technologies. Evaluate the utility of a follow-on study of this issue.
7. Assess whether AFRL's military/civilian mix, military grade structure, use of 06s and SESs, and the implementation of STW21 are assets or inhibitors to mission effectiveness.
8. Success in meeting goals of the Space Commission.

Other Issues Identified

1. Lack of a long term vision to guide AF S&T investments
2. Aligning investment decisions with AF priorities
3. Investing in MANTECH
4. Developing metrics to measure AFRL's performance
5. Investing in technologies to enhance sustainment of fielded systems
6. Human systems integration in C2 systems
7. Integration of AFOSR within AFRL
8. Quality of models & simulations available to evaluate advanced technologies
9. Accuracy in the use of language
10. Maintaining focus while leveraging customer funded research
11. Synergies Among IHPTET, VAATE, Engine CIP, Avionics CIP, Aging Aircraft and MANTECH (Addition to TOR)
12. Managing The Small Business Innovative Research Program (Addition to TOR)
13. AFRL/CC's plan to transform AFRL (Addition to TOR)

How We Did Our Job

- Received 53 Briefings
- Heard from all nine TDs and AFOSR
- Toured 3 representative lab facilities
- Reviewed previous studies
- Held approximately 137 hours of panel meetings
- Conducted independent analysis
- Collaborated via e-mail and through a dedicated web site to prepare final briefing/report

Schedule of Panel Meetings

- 14-16 Dec 04 WPAFB
- 18-20 Jan 05 Kirtland AFB
- 23-25 Feb 05 Washington DC
- 22-24 Mar 05 Rome, NY
- 5-8 Apr 05 WPAFB
- 27 Apr 05 Peterson AFB
- 18 May 05 Hurlburt Field
- 19 May 05 WPAFB
- 20 May 05 Scott AFB
- 31 May 05 Langley AFB
- 3 Jun 05 WPAFB

Contributors to The Study

- 14 Dec General Greg Martin AFMC/CC Mr. Les McFawn AFRL/CD BGen Perry Lamy AFRL/CC Dr. Bob Selden SAB Dr. Dan Hastings SAB/Fmr AF Chief Sci. Col Dave Walker AFRL/CV Mr. Dan Faulkner AFMC/XRS Mr. Rick Peters AFMC/XRA
- 15 Dec Mr. Dave Rubertus AFRL/XPP Dr. Don Paul AFRL/VA Dr. Brendan Godfrey AFOSR Mr. Jack Blackhurst AFRL/XPX-IRAD Col Mike Heil AFRL/PR Dr. Charlie Browning AFRL/ML (Tour)
- 16 Dec Mr. Jack Blackhurst AFRL/XPX Col Mike Leahy AFRL/VA Col Mike Shepard AFRL/XPS

Contributors to The Study

- 18 Jan Dr. Pace Van Devender Sandia Lab Mr. Jeff Bloch Los Alamos Lab Dr. Tom Cruse AFRL/CT Col Rex Kiziah AFRL/VS
- 19 Jan M/Gen(R) Dick Paul Ex AFRL/CC Dr. Bruce Simpson AFRL/DE Mr. Bill Maikisch SMC/CD B/Gen Tom Sheridan AFSPC/DR
- 23 Feb Dr. Alex Levis Fmr AF Chief Scientist Dr. Brendan Godfrey AFOSR Mr. Jim Engle SAF/AQR Lt/Gen John Corley SAF/AQ
- 24 Feb Dr. Bill Borger AFRL/XP Gen(R) Les Lyles Ex AFMC/CC Dr. Steve Wax DARPA Dr. Charlie Holland DDR&E Dr. Arun Seraphin Staffer
- 25 Feb Col Tim Sakulich AFRL Trans. Team

Contributors to The Study

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- 23 Mar Dr. Jim Cunningham ESC/CD Mr. Jerry Duessant AFRL/IF-HE Dr. Mark Lewis AF Chief Scientist Dr.Lou Metzger Mitre Corp. Mr. Ray Urtz AFRL IF (Tour)
- 5 Apr M/Gen(R) Paul Nielsen Ex AFRL/CC B/Gen Perry Lamy AFRL/CC B/Gen Tom Travis ASC/HSW
- 6 Apr B/Gen Ted Bowlds ASC/PEO Dr. Bill Borger AFRL-SBIR Mr. Tom Delinoski AFMC/XP
- 7 Apr Col Mike Leahy AFRL-FLTCs Mr. Jim Mattice Ex SAF/AQ
- 19 May Col Tim Sakulich AFRL Trans. Team

Contributors to The Study

- **27 Apr Gen Lance Lord & AFSPC Staff AFSPC/CC**
- **18 May Lt Gen Mike Wooley & AFSOC Staff AFSOC/CC**
- **20 May Gen John Handy & AMC Staff AMC/CC**
- **31 May Gen Ron Keys & ACC Staff ACC/CC**
  MajGen Tommy Crawford AFC2ISRC/CC

Discussion Sequence

1. Developing a Vision to Guide Air Force S&T Investments
2. Balancing Near, Mid & Far Term Efforts - (TOR 1.b)
3. Cross Directorate, Multi-Disciplinary Concepts/Solutions - (TOR 2.b)
4. Relevance of AFRL Structure and Processes to Support Capability Based Planning - (TOR 2.a & 4)
5. Aligning AFRL's Resource Allocation Decisions with AF and AFRL Priorities
6. Customer Perceptions of AFRL's Value – (TOR 1.a)
7. Technology Transition - (TOR 3)

Discussion Sequence

8. Developing Manufacturing Technologies to Affordably Produce New Technologies
9. Metrics
10. Sustainment
11. Is AFRL's Military/Civilian Mix an Asset or Inhibitor to Mission Effectiveness - (TOR 7.a)
12. Is AFRL's Use of SES's and 0-6's an Asset or Inhibitor to Mission Effectiveness - (TOR 7.b)
13. Human systems integration
14. Integration of AFOSR
15. Modeling & Simulation
16. Accuracy in language

Discussion Sequence

17. Is STW21 An Asset or Inhibitor to Mission Effectiveness - (TOR 7.c)
18. Follow-On Study To Compare AFRL With Other Service Labs (TOR 1.c)
19. AFRL relationships w/DOD & National Labs - (TOR 5)
20. Insights on Interaction with Industry - (TOR 6)
21. Meeting Goals of the Space Commission - (TOR 8)
22. Synergies Among IHPTET, VAATE, Engine CIP, Avionics CIP, Aging Aircraft and MANTECH - (TOR Add 1)
23. Managing The Small Business Innovative Research Program – (TOR Add 2)
24. Maintaining focus while leveraging customer funded research
25. AFRL CC's Transformation Plan

Except for # 25, The Sequence Reflects <u>Our</u> View Of Their Order Of Importance

If You Forget Everything Else, Please Remember This …

- It's about the Air Force's long term vision – if you don't care where you're going, any path will get you there
- Follow the money – he who controls it sets the agenda
- Innovation will happen when people with problems mix with technologists with solutions
- Good people will make any system work, but they need a "Home" where they can grow and be nurtured

Developing a Vision to Guide Air Force S&T Investments

- **Findings and Observations:**
  - **AF has no long term vision comparable to "Toward New Horizons" to guide its investments in S&T**
  - **Of the many attempts to create such a vision, only two have endured to serve their intended purpose – Toward New Horizons and Project Forecast I**
  - **Key to those successes was participation by current and future AF leaders who carried the vision with them to positions of influence within the Air Force**

Developing a Vision to Guide Air Force S&T Investments

- **Recommendations:**
  - **CSAF personally sponsor a "futures study" with two deliverables:**
    - **A Corporate AF Technology Vision, and supporting goals, to focus S&T investments & future concept development**
    - **An actionable corporate strategy to create revolutionary capabilities for tomorrow's Air Force, with clear accountability for action at the corporate AF level**
  - **Study should involve a diverse set of military and DoD civilian leaders (AF, sister service, SOF, DHS), technologists, futurists, etc.**
  - **Participants should include hand picked officers and civilian equivalents – from three star to field grade – with high potential to rise to senior leadership positions within the Air Force**

Developing a Vision to Guide Air Force S&T Investments

- **Recommendations (cont):**
  - **Drawing on this vision, identify specific technologies with the potential to revolutionize the way the AF accomplishes its missions**
  - **Allocate a meaningful level of resources to advance those technologies**
  - **Review progress annually <u>at Corona</u>**
    - **Doing at Corona, as with AF Academy, would help establish corporate ownership of S&T program and be more enduring than a stand alone summit**

Balancing Near, Mid & Far Term Efforts (TOR 1.b)

- **Findings and Observations:**
  - **The AF balances its S&T investments by setting targets for 6.1, 6.2 and 6.3 research as a percentage of the S&T budget**
    - **~ 14%/50%/36%**
  - **Salaries consume most of AFRL's 6.2 budget, leaving "customer" reimbursements to fund contracted 6.2 research**
  - **The AF now reduces AFRL's 6.2 budget by an amount equal to the salary portion of customer reimbursements; leaving less funding for 6.2 research in each successive year**

his Is A Death Spiral For Applied Researc

Balancing Near, Mid & Far Term Efforts (TOR 1.b)

- **Findings and Observations (cont):**
  - **6.1/6.2/6.3 are not the same as far/mid/near term research**
  - **Using "years to TRL-6" as a metric, AFRL (other than AFOSR) does little research with a long term focus**
    - **Of 318 projects with a TRL-6 estimate, 7 mature in ten years or more and 191 mature in five years or less**
  - **An enduring Air Force vision would help guide and justify investments in "tomorrow's" Air Force**

Balancing Near, Mid & Far Term Efforts (TOR 1.b)

- **Recommendations:**
  - **Develop a metric that is more useful than 6.1, 6.2 and 6.3 funding**
    - **E.g., project funding or # of projects by estimated TRL-6 date**
  - **Continue to develop the FLTC process to help focus and integrate AFRL's near, mid and far term research**
  - **Rescind the AF tax on customer reimbursements**
    - **Otherwise, you are in a death spiral that will eliminate 6.2 contracted research**
    - **And eventually drive a significant reduction in the S&T workforce**

Cross Directorate, Multi-Disciplinary Concepts/Solutions
(TOR 2.b)

- **Legend: Funds for several technologies needed to find "Tanks Under Trees" (TUT) were cut by TDs who favored "stove pipe" priorities over AF priorities**
- **Fact:**
  - **After first S&T Summit ('00), AFRL was funded for TUT initiative**
  - **During budget drill in summer of '00, AQR zeroed TUT funding**
  - **When CSAF expressed frustration at Fall '00 S&T review, AQR took responsibility for cuts and restored '02-'04 funding**
  - **After AQR restored the program, SN moved ~ $1M from other SN projects to kick-start TUT in '01 & added another $.5M in '03**
- **Conclusion: TUT saga offers no evidence that TDs place internal priorities before those of corporate AF**
  - **AFRL tried to apply AF priorities, but was constrained by AQ control of budget**

~~- An Urban Legend~~
-Correcting the Record

Cross Directorate, Multi-Disciplinary Concepts/Solutions
(TOR 2.b)

- **Findings and Observations:**
  - **Most cross-directorate, multi-disciplinary projects arise from individual initiative vice top down direction**
  - **Interest in such projects is stimulated by interaction with S&Es from other disciplines and directorates, and by interaction with operational users**
  - **Sustaining such projects becomes more difficult as they mature and resource requirements expand**
- **Recommendations:**
  - **Protect funding for S&E attendance at research symposia and conferences**
  - **Create frequent opportunities for S&Es to interact with operational users**
  - **Establish an organization & process focused on identifying and nurturing cross directorate, multi-disciplinary projects**

Relevance of AFRL Structure and Processes to Support Capability Based Planning

(TOR 2.a & 4)

- **Findings and Observations:**
  - **AFRL has fully embraced capability based planning and uses CRRA capability gaps to guide resource allocation decisions**
  - **The CRRA has a near term focus, which could reinforce the trend toward near term research that this and other review groups have noted**
  - **AFRL's FLTC complements the CRRA by providing a comparable focus for research projects with a long term orientation**
  - **Transitioning revolutionary technologies requires AFRL to "market" them to users**

Relevance of AFRL Structure and Processes to Support Capability Based Planning

(TOR 2.a & 4)

- **Recommendations :**
  - **Mature the CRRA process to incorporate a robust treatment of mid and long term capability gaps**
  - **Expand the FLTC process to include:**
    - **A more comprehensive set of long term challenges**
    - **Participation by AF HQ and the operational commands**
  - **AFRL develop a marketing mentality to advance “tech push” initiatives**

Aligning AFRL's Resource Allocation Decisions with AF and AFRL Priorities

- **Findings and Observations:**
  - **The Air Force has no enduring vision to guide long term S&T investment strategies**
  - **AFRL's recently developed Corporate Investment Strategy has the potential to better align AFRL's resource allocation decisions with AF and AFRL priorities**

Aligning AFRL's Resource Allocation Decisions with AF and AFRL Priorities

- **Recommendations:**
  - **Continue to mature the AFRL Corporate Investment Strategy to guide the prioritization of AF S&T investments**
    - **Add a process to monitor budget execution**
    - **Add a process to reallocate execution year funding across AFRL when conditions warrant**
  - **Give control of funds for important cross-directorate projects to project managers**

FOLLOW THE MONEY!

Customer Perceptions of AFRL's Value
(TOR 1.a)

- **Findings and Observations:**
  - **Operating commands are generally satisfied with their interaction with AFRL and think AFRL is working on the right technologies**
  - **AFSPC has the strongest connection to the lab of the four commands visited and holds a highly regarded S&T day in conjunction with its ATC**
    - **Highest S&T priority is affordable access to space**
  - **AFSOC is frustrated by ATC process because they have little/no money to fund transition of ATDs**
    - **Highest S&T priority is dealing with Helicopter brown outs**
  - **AMC is focused on the next generation airlifter**
    - **Highest S&T priority is autonomous landing capability**

Customer Perceptions of AFRL's Value
(TOR 1.a)

- **Findings and Observations:**
  - **ACC wants interoperable, net ready solutions that don't require them to field a "bridge" to make them work**
    - **Effective "beam" weapons would be revolutionary**
  - **All but ACC share TOS panel's concerns that AF lacks a long term vision and that AFRL is being pulled to a near term focus**
  - **AFMC product and log center connection to AFRL is not strong – they often look to industry first when they need a technology solution**

Customer Perceptions of AFRL's Value (TOR 1.a)

- **Recommendation:**
  - **Negotiate “exchanges of hostages” with the operational commands – weeks to months long TDYs**
    - **S&Es gain exposure to operational problems while doing meaningful field research - focused at the squadron level**
    - **Operators gain understanding of lab while collaborating with S&Es on research relevant to their mission area**
    - **Could eliminate need for liaisons that are often of marginal utility**
  - **Implement similar measures with the product centers**
    - **More on this under tech transition**

Technology Transition
Some Relevant History

- **Systems Command was abolished in 1992**
  - **Had served as AF focal point for technology and systems development**
  - **Had an institutional focus on the future Air Force**
- **In mid-90s, Congress cut funds for developmental planning in product centers as a way to reassert control over new starts**

Technology Transition
Some Relevant History

- ’97 lab restructure disconnected AFRL from the Product Centers
  - Product Center linkage helped AFRL focus on relevant technologies
  - Linkage also provided path for technology transition
- Slow pace of fielding new systems limits opportunity for technology transition
  - Aggravated by ’90s procurement holiday

Technology Transition
(TOR 3)

- **Findings and Observations:**
  - **Tech transition (other than IT) is harder than it used to be**
    - **15+ years of "acquisition reform"**
    - **Fewer new weapon systems**
    - **Loss of "flight demo" funding & high cost of space demos**
  - **Transition of technology to application in a weapon system typically requires three things:**
    - **User has to want and have the money to pay for it**
    - **Contractor has to propose and be capable of producing it**
    - **PM must accept the inherent risk to cost and schedule**
  - **Improving tech transition will require actions by the Congress, DoD and the Air Force; as well as by AFRL**

Technology Transition (TOR 3)

- **Findings and Observations (cont):**
  - **Atrophy of development planning in AFMC eliminated a successful technology transition mechanism**
    - **Elements of this process are currently being restored as "Capability Planning" by product center XRs**
  - **Applied Technology Councils enhance the potential for technology transition**
    - **AFRL/CC and Product Center/CC participation enhances this process**
    - **Most ATC agendas are narrowly focused on ATD prioritization**
    - **AFSPC ATCs incorporate a broad S&T exchange as well as a prioritization of ATDs**

Technology Transition (TOR 3)

- **Recommendations:**
  - **Continue rebuilding a Developmental Planning function at the Product Centers – now called Capability Planning**
  - **AFRL work closely with Product Center XRs**
    - **Engage in all product center concept refinement activities**
    - **Establish a personnel exchange program: assign AFRL S&Es to product center XRs and people from product center XRs to AFRL ATD project offices**
  - **AFRL/CC and Product Center/CCs participate in ATCs**
  - **Make ATCs event rather than calendar driven**
    - **Twice each year is probably too frequent**
  - **Encourage all commands to combine an S&T Day with their ATC**
    - **S&T day to cover the full range (near/mid/far) of AFRL technology efforts**

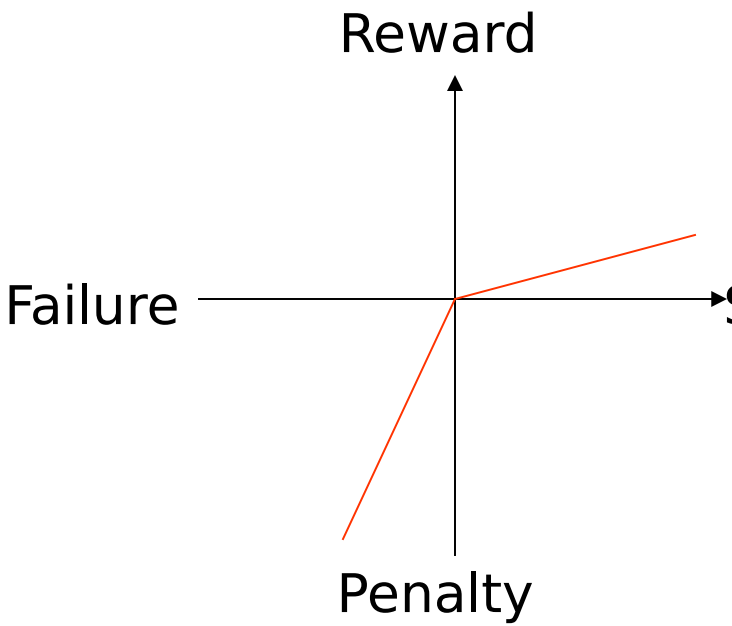
Technology Transition (TOR 3)

- **Recommendations (cont):**
  - **Regenerate a once successful problem & solution discovery process – "Mixing Bowls"**
    - **AFRL and users identify operational tasks to be analyzed in user/scientist workshops facilitated by retired 3 or 4-star moderator**
    - **Users describe in detail the planning and execution of the task and capabilities they wish they had**
    - **S&Es brainstorm solutions to "I wish I hads" and to problems not recognized by user but apparent to S&Es**
    - **Operators & S&Es rank the solutions which become prioritized S&T initiatives**

Technology Transition (TOR 3)

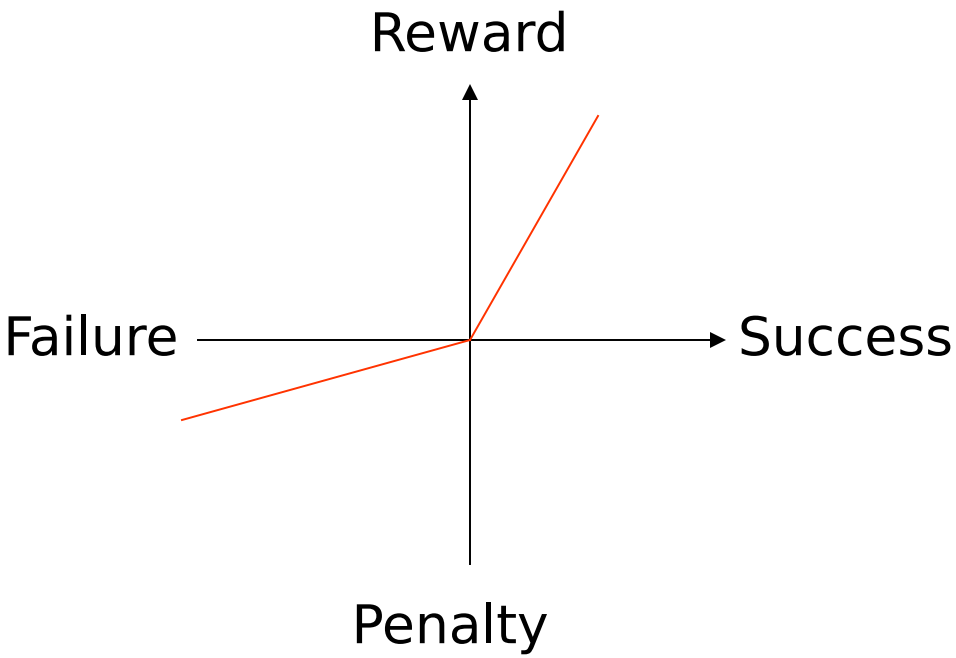
- **Recommendations (cont):**
  - **AFRL should promote a risk tolerant culture based on the venture capitalist model**

Not this



DoD Model

This!



Venture Capitalist Model

Developing Manufacturing Technologies to Affordably Produce New Technologies

- **Findings and Observations:**
  - **In some cases, the transition of new technologies to the force requires development of new ways to affordably produce those technologies.**
    - **E.g., new fabrication and assembly technologies to build stealthy aircraft**
  - **A new AFRL Systems Engineering policy requires that ATDs address manufacturability**
    - **However, the policy does not address MRLs**

Developing Manufacturing Technologies to Affordably Produce New Technologies

- **Findings and Observations (cont):**
  - **AF views development of manufacturing technologies to be largely the responsibility of the defense industry**
    - **Industry is reluctant to make these investments without some assurance of a return on their investment**
    - **This undermines the Air Force's ability to transition AFRL developed technologies to the field and to sustain them**

Developing Manufacturing Technologies to Affordably Produce New Technologies

- **Recommendations:**
  - **AFMC/AFRL should champion a renewed AF commitment to develop manufacturing technologies**
  - **AFRL should develop and use manufacturing readiness levels (MRLs) to complement TRLs**

Metrics

- **Findings and Observations:**
  - **Developing metrics for AFRL is a difficult but necessary undertaking, but a bad metric is worse than no metric at all**
  - **People will "improve" the things that you measure, but outcomes will only improve if you measure the right things in the right way**

Metrics

- **Findings and Observations (cont):**
  - **AFMC's "Balanced Scorecard" initiative has identified many possible metrics for AFRL, but most focus on inputs vice outcomes, e.g.,**
    - **S&T Research Sponsorship: More customer funding is better**
      - **Is that true? How about the "6.2 effect"?**
    - **% of 6.3 linked to I-CRRA gaps: Higher is better**
      - **Is the goal 100%? Should some 6.3 be tech push?**
    - **% of tech staff with PHD, MS, BS: More is better**
      - **Should degrees be relevant, or are all degrees equal?**

Metrics

- **Findings and Observations (cont):**
  - **The AF SAB rates the *quality* and *long term relevance* of AFRL research**
    - ***Relevance* was once rated by the using commands and product center XRs**
    - **Users and XRs do not currently rate the relevance of AFRL research, other than ATDs**
  - **Measuring the relevance of AFRL research is handicapped by the absence of good campaign level metrics**
    - **Current metrics focus on linear operations at the tactical level, e.g., FEBA movement, percent of tanks destroyed, etc**
    - **The relevance of AFRL's research should be evaluated using metrics appropriate for distributed operations, irregular warfare, etc**

Metrics

- **Recommendations:**
  - **AFRL develop metrics that focus on outcomes rather than inputs**
  - **Direct that all RD&A RFPs require contractors to identify technologies used in proposals that derive from AF funded research**
    - **Would support metric for tech transition**
  - **Have product center XRs and users evaluate the relevance of near and mid term research to complement AF SAB's evaluation of far term S&T**

Sustainment

- **Findings and Observations:**
  - **Advanced technologies often require advanced depot and field support capabilities**
  - **AFRL investments in sustainment are declining**
  - **Sustainment has a low priority in the CRRA**
  - **AFRL developed technologies have enhanced sustainment in the past**
    - **E.g., Engine Rotor Life Extension, wiring and corrosion protection & inspection programs**
  - **AFRL has recently added Sustainment Transformation Through Technology (ST3) as an FLTC**

Sustainment

- **Recommendations:**
  - **AFRL continue to advocate ST3 within AFMC and the ALCs to include;**
    - **Funding guidance in the CIS**
    - **Continued support for ST3 as an FLTC**
  - **AFMC and AFRL continue to work with AF/IL to highlight sustainment issues in the CRRA**
  - **AFMC develop and field technologies, including MANTECH to enhance depot support of AF systems**

Is AFRL's Military/Civilian Mix an Asset or Inhibitor to Mission Effectiveness (TOR 7.a)

- **Findings and Observations:**
  - **Military in lab are valuable and necessary**
    - **Young officers = fresh ideas, enthusiasm**
    - **Mid-level officers = broader perspective, operational experience**
    - **Senior leaders with technical experience = valuable leadership perspective, both in lab and the broader AF**

"Scientific results cannot be used effectively by soldiers who have no understanding of them, and scientists cannot produce results useful for warfare without an understanding of the operations." **Dr. Theodore Von Karmen**

Is AFRL's Military/Civilian Mix an Asset or Inhibitor to Mission Effectiveness
(TOR 7.a)

- **Findings and Observations (cont):**
  - **The current mix is heavy on Lts and light on field grades**
    - **9 colonels, 33 Lt Cols, 48 Majs, 124 Capts, and 391 Lts**
    - **Very narrow path for growth to senior leadership positions**
    - **"Entitlements" can make this worse - if AFRL can't fill a position, they sometimes convert it to civilian - they then lose another military entitlement, since entitlements are based on a percentage of authorized military positions**
  - **AFPC says accession/retention outlook shows improvement in both 6.1S and 6.2E**

Is AFRL's Military/Civilian Mix an Asset or Inhibitor to Mission Effectiveness (TOR 7.a)

- **Findings and Observations (cont):**
  - **CSAF *"Sight Picture"* Nov 2002 launched AF-wide force development effort to include scientists and engineers, both military and civilian**
    - **Functional Manager for USAF 6.1 and 6.2 is SAF/AQR**
    - **Working with AFPC to construct Force Development model**
  - **Although AQR commissioned a requirements review in 2001, AFRL does not have well defined 6.1S and 6.2E manpower requirements**

Is AFRL's Military/Civilian Mix an Asset or Inhibitor to Mission Effectiveness (TOR 7.a)

- **Recommendations:**
  - **Expedite construction and implementation of 6.1S, 6.2E and 6.3A force development models**
    - **Emphasize development of high quality program managers and technology leaders**
  - **In conjunction with SAF/AQ, charter a comprehensive review by AFMA of requirements for military and civilian workforce in AFRL**

Is AFRL's Use of SES's and 0-6's an Asset or Inhibitor to Mission Effectiveness
(TOR 7.b)

- **Findings and Observations:**
  - 4 TD's headed by Colonels with SES's as deputy directors – MN, VS, PR, VA
    - Appears to work
    - "Personalities" probably play a role in success
    - SESs provide important "senior AF" presence in DOD forum
- **Recommendation:**
  - AFRL should explore if SLs or STs are more appropriate than SESs as deputy directors when the director is a colonel

Human Systems Integration

- **Findings and Observations:**
  - **Net-centric warfare & effects based operations increase importance of Human Systems Integration (HSI)**
  - **There is still "science" to be developed in the human factors area – high altitude ops, g-stress, fatigue, etc**
  - **The most glaring deficiency is found in integration of human factors with C2 systems and processes**
  - **A new AFRL Systems Engineering policy requires that ATDs work with HE to identify and resolve HSI issues**

Human Systems Integration

- **Recommendations:**
  - **Stand up a team of dedicated HE, IF & SN members to work C2 issues - CAOC and beyond**
  - **Fully implement AFRL's Systems Engineering policy to insure early HE involvement in all ATDs and ACTDs**
  - **Develop and use Human System Integration Readiness Levels (HRLs) similar to TRLs & MRLs**
  - **Define other critical cognition/information optimization areas that could best be worked by such integrated teams**

Integration of AFOSR

- **Findings and Observations:**
  - **AFOSR is not fully integrated into AFRL's long term planning processes**
  - **AFOSR has recently begun to increase program managers contact with the operating Air Force**
  - **Globalization adds to the already difficult challenge of keeping AFRL S&Es apprised of non-AF sponsored basic research activities**
  - **Intramural 6.1 research is an important tool for developing future S&T technology leaders**
    - **AFOSR commits 30% of their Defense Research Sciences PE to Air Force intramural research**

Integration of AFOSR

- **Recommendations:**
  - **Institutionalize recent initiatives to target 6.1 research on long-term aspects of FLTCs, e.g., research community workshops focused on each of the FLTCs**
  - **Promote increased engagement between AFOSR program managers and directorate researchers**
  - **Emphasize AFOSR's responsibility to keep AFRL S&Es informed of relevant national and international basic research activities**
  - **Increase AFOSR program managers' contact with the operating Air Force**
  - **Emphasize AFSOR's responsibility to help grow future AF S&T leaders through aggressively supporting in-house research**
    - **Reevaluate whether 30% is an appropriate allocation of the Defense Research Sciences PE to Intramural 6.1 research**

Modeling & Simulation

- **Findings and Observations:**
  - **Operators often under-value advanced technologies**
    - **E.g., operators saw little value in data links or GPS Navigational Satellites**
  - **Contribution of revolutionary technologies cannot be measured using operational concepts, models and simulations optimized for today's technologies and today's operational environments**
  - **AFMC/AFRL are developing System-of-Systems campaign level models and simulations using a process called Capability Focused Technology Investment (CFTI)**

Modeling & Simulation

- **Recommendations:**
  - **Energize AFRL's involvement in AFMC/XRs M&S efforts**
    - **Develop system-of-systems M&S capabilities**
    - **Develop campaign models to better represent "game changing" technologies in future environments**
    - **Continue development of the CFTI process and supporting concept development, modeling and simulation efforts**
  - **Encourage participation by the operating commands in development of future operating concepts, models and simulations**

Accuracy in Language

- **Findings and Observations:**
  - **Lack of clarity in language and directives can lead to confusion and unfocused work in AFRL**
  - **Words such as transformation, warfighting/warfighter, battlespace, net-centric, etc are used to describe important objectives or processes, but their definitions are unclear**
  - **E.G., transformation: Used as a modifier or end state for countless projects (including ours!). Has no accepted definition and can mean either something a little new or something the AF has always done. Transformation should mean at least an order of magnitude change in effect, cost, or core characteristic of a system**
- **Recommendations:**
  - **Stop using "buzz words" that have no clear definition or that require reference to a glossary to understand their meaning**
  - **Develop a primer to clearly define those terms that cannot be eliminated, such as "effects based operations"**

Is STW21 An Asset or Inhibitor to Mission Effectiveness
(TOR 7.c)

- **Background:**
  - **STW21 recommended AFRL leadership be empowered to continue strategic transformation of the lab**
  - **STW21 recommended a GOCA model**
  - **STW21 recommended the AF stabilize S&T funding and provide "top cover" at the HQ Air Force level**
- **Findings and Observations:**
  - **Air Force has empowered AFRL leadership, but congress or other stakeholders could constrain AFRL's freedom of action**
  - **It is not clear the <u>quality</u> of collaboration meets the standard set by STW21, i.e. collaborators of "high national reputation"**
  - **Air Force S&T funding has not been stable over any meaningful time frame, although commitment to 3% real growth has been met since 2000**

Is STW21 An Asset or Inhibitor to Mission Effectiveness
(TOR 7.c)

- **Recommendations:**
  - **Continue implementation of the STW-21 vision**
  - **Establish metrics to track participation by collaborators of "high national reputation" as differentiated from support contractors**
  - **Appeal to senior AF leaders to renew their commitment as stewards of tomorrow's AF by providing robust and stable funding to their S&T program**

A Follow-On Study To Compare AFRL With Other Service Labs

(TOR 1.c)

- **Finding: There may be lessons to be learned from other Service labs, but it is not clear that a formal study is needed**
- **Recommendation: AFRL/CC visit the Navy and Army labs with a few key staff members to compare processes & procedures**
  - **If deemed useful, commission a follow-on study to examine specific "best practices" identified**
  - **A broad based study without this kind of focus is unlikely to yield useful results**

AFRL relationships w/DOD & National Labs
(TOR 5)

- **Findings and Observations:**
  - **Lab Demo has effectively eliminated the disparity between AFRL and the National Labs' ability to hire and retain top S&Es**
    - **But the new DoD civilian management system could erode some of these gains**
  - **Sandia National Lab has some operational constructs that may be of interest to AFRL**

AFRL relationships w/DOD & National Labs
(TOR 5)

- **Recommendations:**
  - **The AFRL "Change Team" visit Sandia for a briefing on how they execute research programs**
  - **Do not pursue a follow-on study of AFRL relationships with DOD and National Labs**

Insights on Interaction with Industry
(TOR 6)

- **Findings and Observations:**
  - **Interactions with industry declined after demise of formal IRAD reviews and IRAD reporting**
    - **VA and PR have continued informal IRAD reviews**
    - **AFRL sponsors Industry Days for the ASC, AAC, & SMC communities**
  - **Contracted Research & Development, and Cooperative Research & Development Agreements are now the dominant form of interaction**
    - **Help build relationships and encourage communication between AFRL and industrial technical peers and leaders**
    - **Enable ad hoc discussions on topics of mutual interest**

Insights on Interaction with Industry
(TOR 6)

- **Findings and Observations (cont):**
  - **Boeing Phantom Works provides periodic updates on its technology portfolio and programs to government customers**
  - **AFRL recently initiated formal IRAD reviews to complement informal reviews done by VA and PR**
  - **AFRL/XP's recently established "Shopping Mall" web site for SBIRs could stimulate additional industry interaction**

Insights on Interaction with Industry
(TOR 6)

- **Recommendations:**
  - **Expand IRAD initiative to all major contractors and AFRL TDs**
  - **Emphasize continued use of “Industry Days” to provide insights to industry on AFRL development plans/FLTCs and to solicit ideas from industry**
  - **Apprise contractors of AFRL/XP “Shopping Mall” website for SBIR information/interaction**
  - **No follow-on study of this issue is warranted**

Meeting Goals of the Space Commission
(TOR 8)

- **Findings and Observations:**
  - **AFRL is:**
    - **Coordinating S&T investments with the rest of the U.S. space technology community**
    - **Increasing space S&T funding**
      - **But planned growth was eroded by PBD 753**
    - **Investing in leading edge military space technologies & pursuing technology demos in space**
      - **But making few investments in far term research**
    - **Planning FLTCs to guide advances in space technology**
      - **But they are not yet implemented**
    - **Including its military & civilians in the space cadre**
      - **But few have been certified**

Meeting Goals of the Space Commission
(TOR 8)

- **Findings and Observations (cont):**
  - **AFRL is:**
    - **Receiving AFSPC oversight of its space S&T investments**
      - **<u>But</u> that may contribute to an emphasis on near and mid term S&T**
    - **Increasing its space ManTech budget**
      - **<u>But</u> the pending joint SMC & AFRL "Space Industrial Base Assessment" is expected to identify concerns with the space industrial base**
- **Recommendations:**
  - **Continue to emphasize compliance with the recommendations of the Space Commission**
  - **Help address the "buts" highlighted in these findings**

Synergies Among IHPTET, VAATE, Engine CIP, Avionics CIP, Aging Aircraft and MANTECH
(TOR Add 1)

- **Findings and Observations:**
  - **Engine CIP, IHPTET and VAATE have solid processes**
  - **Aging Aircraft does not have solid processes and tends to be reactive**
  - **Avionics CIP is not funded so could not be evaluated**
  - **MANTECH is a cross cutting technology discipline**

Synergies Among IHPTET, VAATE, Engine CIP, Avionics CIP, Aging Aircraft and MANTECH
(TOR Add 1)

- **Recommendations:**
  - **Don't "fix" Engine CIP, IHPTET and VAATE**
    - **They have solid processes**
  - **Aging Aircraft should adopt processes used in the engine programs**
  - **MANTECH is a cross cutting technology discipline and should not be subsumed within Aging Aircraft or any other sector**

Managing The Small Business Innovative Research Program
(TOR Add 2)

- **Background:**
  - **SAF/AQ is concerned about pace & rate of tech transition from SBIR**
  - **Slow execution prompted AF to withhold some program funding**
  - **Public comments by program manager prompted congressional interest**

Managing The Small Business Innovative Research Program
(TOR Add 2)

- **Findings and Observations:**
  - **SBIR = 2.5% of 3600; Small Business Tech Transfer (STTR) = .3%; Admin = .01%**
    - **~$350M/Yr**
  - **OSD approves ~ 250 topics each year for SB to propose against, resulting in ~1000 contracts**
    - **Phase 1 = < $100K; phase 2 = $100K-$750K**
    - **~ 50% move from phase 1 to phase 2 (62% last year)**
    - **Phase 3 = product ready for insertion; but rate of movement to phase 3 is not tracked**
    - **Programs are executed through AFRL, the ALCs and the Test Center**
  - **Improving SBIR requires a focus on doing relevant research and finding ways to measure benefits**
  - **Shopping mall web site should help, as would getting industry involved in selection of topics**

Managing The Small Business Innovative Research Program
(TOR Add 2)

- **Recommendation:**
  - **Continue developing the shopping mall web site**
    - **It is a good vehicle for transitioning SBIR to industry**
  - **Integrate SBIR into IRAD reviews**
  - **Solicit industry input on selection of topics**

AFRL/XP is working this issue properly

Maintaining Focus on the Air Force Mission While Fully Leveraging Non-Air Force Funding Sources

AFMC

- **Findings and Observations:**
  - More than 40% of AFRL research is "customer" funded, much higher in some TDs
  - At some point the level of outside work could dilute the identity of AFRL as an Air Force lab
- **Recommendation:**
  - Establish guidelines and a review (vice approval!) process to ensure that customer funded work is accepted only when well aligned with AF interests

AFRL CC's Transformation Plan

- **The panel endorses the enterprise process model and resource allocation strategy included in the plan**
- **The plan has the potential to effectively address the most serious issues identified during this study and unfinished business from the '97 reorganization**
  - **Protecting long term research with revolutionary potential**
  - **Improving horizontal integration across the lab**
  - **Facilitating technology transition**
  - **Providing corporate guidance and direction for the allocation and prioritization of AFRL's resources**
  - **Improved integration of the 6.1 program**
- **However, the way forward is fraught with risk, particularly with regard to the organizational construct**

***All comments based on April 5 briefing from AFRL/CC and May 19 brief on resource allocation strategy by Colonel Tim Sekulich**

AFRL CC's Transformation Plan

- **Recommended Guiding Principles:**
  - **Get "buy in" across the lab**
  - **Roll out major organizational changes as a complete package**
  - **Matrix S&Es (including PMs) to CP-2 and CP-3 from CP-1 technology based "home rooms" to which they will return**
    - **Allows AFRL to stabilize the S&E UMD while accommodating ebb and flow of activity in CP-2 and CP-3**
    - **Preserves "critical mass" in core technologies and "functional management" for S&Es within CP-1**
    - **Preserves integrity of linkage between 6.2 and 6.3 research**
    - **Help preserve long standing relationships among S&Es that facilitate quality research, within and external to AFRL**

AFRL CC's Transformation Plan

- **Recommended Guiding Principles (cont):**
  - **Maintain a balance of responsibilities and authorities across the major elements of AFRL**
    - **The director of CP-1 appears to have an overly broad span of responsibility**
  - **Maintain a balance of military and civilian participation on the AFRL corporate board**
  - **Acknowledge Congressional and other outside stakeholder interest in AFRL**
    - **Seek advice and counsel, especially on changes involving AFOSR**

AFRL CC's Transformation Plan

- **Recommended Guiding Principles (cont):**
  - **Preserve the quality of the S&E workforce**
    - **Maintain career growth opportunities for S&Es**
    - **Develop incentives that are balanced between program management and bench level science and engineering**
    - **Mitigate the loss of continuity in technical leadership that may result from the frequent rotation of SESs**
  - **Provide advocacy for cross cutting technologies/issues**
    - **E.g., Sustainment, MANTECH, Industrial Base, Human Factors, Training and Education**
  - **Preserve an Air Force corporate conscience for basic research**
    - **A role currently filled by AFOSR**

AFRL CC's Transformation Plan

- **Some final thoughts:**
  - **AFRL is a pretty solid organization**
  - **Major restructure should be last resort - undertaken only if process improvements and modest organizational changes cannot achieve the goals**
  - **AFRL has adapted during the course of this review, and several recent initiatives have the potential to enhance AFRL's performance if institutionalized**
    - **CRRA, FLTCs, Capability Planning in Product Center XRs, CIS, IRAD Reviews**
  - **The "Virtual Laboratory" concept will require a major resource commitment, but is a key enabler of the *one*AFRL vision and would significantly enhance performance of AFRL under any organizational structure**

If You Forget Everything Else, Please Remember This …

- It's about the Air Force's long term vision – if you don't care where you're going, any path will get you there
- Follow the money – he who controls it sets the agenda
- Innovation will happen when people with problems mix with technologists with solutions
- Good people will make any system work, but they need a "Home" where they can grow and be nurtured